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WHAT IS CLAIMED IS:

1 1. An interferometry system for making interferometric measurements of an
2 object, said system comprising:
3 a source assembly that generates an input beam;
4 a detector assembly that includes a detector element; and
5 an interferometer that includes a source imaging system that images the input
6 beam onto a spot on or in the object and an object imaging system that images the spot
7 onto the detector element as an interference beam, said object imaging system combining
8 light coming from the spot with a reference beam to produce the interference beam,
9 wherein the source imaging system is characterized by a first aperture stop that
10 defines a first aperture, said source imaging system including a first phase shifter that
11 introduces a first phase shift in light passing through a first region of the first aperture
12 relative to light passing through a second region of the first aperture, said second region
13 of the first aperture being the region of the aperture that is outside of the first region of
14 the first aperture, and
15 wherein the object imaging system is characterized by a second aperture stop that
16 defines a second aperture, said object imaging system including a second phase shifter
17 that introduces a second phase shift in light passing through a first region of the second
18 aperture relative to light passing through a second region of the second aperture, said
19 second region of the second aperture being the region of the aperture that is outside of the
20 first region of the second aperture.

1 2. The interferometry system of claim 1, wherein the first and second phase
2 shifters are oriented relative to each other such that any component of the input beam that
3 reaches the detector element as a result of being forward scattered/reflected by the object
4 passes through only one of the first and second phase shifters when traversing from the
5 source assembly to the detector element.

1 3. The interferometry system of claim 1, wherein the first and second phase
2 shifters are oriented relative to each other such that any component of the input beam that
3 reaches the detector element as a result of being backscattered by the object passes

4 through either both the first and second phase shifters or through neither of the first and
5 second phase shifters when traversing from the source assembly to the detector element.

1 4. The interferometry system of claim 2 wherein the first phase shift is $\pi/2$ and
2 the second phase shift is $\pi/2$.

1 5. The interferometry system of claim 2, wherein the first region of the first
2 aperture occupies one half of the area of the first aperture and wherein the first region of
3 the second aperture occupies one half of the area of the second aperture.

1 6. The interferometry system of claim 2, wherein the first and second regions of
2 the first aperture are of equal area.

1 7. The interferometry system of claim 5, wherein the first and second regions of
2 the second aperture are of equal area.

1 8. The interferometry system of claim 2, wherein the object imaging system
2 includes a first imaging system, a mask defining a pinhole, and a second imaging system,
3 wherein the first imaging system images the spot on the pinhole of the mask and the
4 second imaging system images the pinhole of the mask onto the detector element.

1 9. The interferometry system of claim 8, wherein the second phase shifter is
2 located in the first imaging system.

1 10. The interferometry system of claim 2, wherein the object imaging system
2 includes a first imaging system and a mask defining a pinhole, and wherein the first
3 imaging system and the source imaging system are both implemented by the same
4 imaging system.

1 11. The interferometry system of claim 10, wherein the object imaging system
2 also includes a second imaging system that images the pinhole onto the detector element.

1 12. The interferometry system of claim 10, wherein the first phase shifter is a thin
2 optical film on a portion of a surface of an optical element within the source imaging
3 system.

1 13. The interferometry system of claim 12, wherein the second phase shifter is
2 also implemented by said thin film.

1 14. The interferometry system of claim 10, wherein the interferometer comprises
2 a catadioptric imaging system that implements both the source imaging system and the
3 first imaging system.

1 15. The interferometry system of claim 14, wherein the catadioptric imaging
2 system comprises a first catadioptric element, a second catadioptric element, and a beam
3 splitter between the first and second catadioptric elements.

1 16. The interferometry system of claim 2, wherein the interferometry system is
2 an interferometric microscopy system.

1 17. The interferometry system of claim 2, wherein the interferometry system is a
2 interferometric confocal microscopy system.

1 18. The interferometry system of claim 2, wherein the interferometry system is
2 an interferometric ellipsometric microscopy system.

1 19. The interferometry system of claim 2, wherein the source assembly comprises
2 a pulsed or shuttered source for generating the input beam.

1 20. An interferometry system for making interferometric measurements of an
2 object, said system comprising:
3 a source assembly that generates an array of input beams;
4 a detector assembly that includes an array of detector elements; and
5 an interferometer that includes a source imaging system that images the array of
6 input beams onto an array of spots on or in the object and an object imaging system that
7 images the array of spots onto the array of detector elements as an array of interference
8 beams, said object imaging system combining light coming from each spot of the array of
9 spots with a corresponding reference beam to produce a corresponding interference beam
10 of the array of interference beams,

11 wherein the source imaging system is characterized by a first aperture stop that
12 defines a first aperture, said source imaging system including a first phase shifter that
13 introduces a first phase shift in light passing through a first region of the first aperture
14 relative to light passing through a second region of the first aperture, said second region
15 of the first aperture being the region of the aperture that is outside of the first region of
16 the first aperture, and

17 wherein the object imaging system is characterized by a second aperture stop that
18 defines a second aperture, said object imaging system including a second phase shifter
19 that introduces a second phase shift in light passing through a first region of the second
20 aperture relative to light passing through a second region of the second aperture, said
21 second region of the second aperture being the region of the aperture that is outside of the
22 first region of the second aperture.

1 21. The interferometry system of claim 20, wherein the first and second phase
2 shifters are oriented relative to each other such that any component of the array of input
3 beams that reaches the detector element as a result of being forward scattered/reflected by
4 the object passes through only one of the first and second phase shifters when traversing
5 from the source assembly to the detector element.

1 22. The interferometry system of claim 21, wherein the first and second phase
2 shifters are oriented relative to each other such that any component of the array of input
3 beams that reaches the detector element as a result of being backscattered by the object
4 passes through either both of the first and second phase shifters or through neither of the
5 first and second phase shifters when traversing from the source assembly to the detector
6 assembly.

1 23. The interferometry system of claim 21, wherein the first phase shift is $\pi/2$ and
2 the second phase shift is $\pi/2$.

1 24. The interferometry system of claim 21, wherein the first region of the first
2 aperture occupies one half of the area of first aperture and wherein the first region of the
3 second aperture occupies one half of the area of the second aperture.

1 25. The interferometry system of claim 21, wherein the first and second regions
2 of the first aperture are of equal area.

1 26. The interferometry system of claim 21, wherein the first and second regions
2 of the second aperture are of equal area.

1 27. The interferometry system of claim 21, wherein the first phase shifter is a thin
2 optical film on a portion of a surface of an optical element within the source imaging
3 system.

1 28. The interferometry system of claim 27, wherein the second phase shifter is
2 also implemented by said thin film.

1 29. The interferometry system of claim 21, wherein the object imaging system
2 includes a first imaging system, a object-side mask defining an array of pinholes, and a
3 second imaging system, wherein the first imaging system images the array of spots on the
4 array of pinholes so that each imaged spot of the imaged array of spots is aligned with a
5 corresponding different one of the pinholes of the array of pinholes and wherein the
6 second imaging system images the array of pinholes onto the array of detector elements.

1 30. The interferometry system of claim 29, wherein the interferometer comprises
2 a catadioptric imaging system that implements both the source imaging system and the
3 first imaging system.

1 31. The interferometry system of claim 30, wherein the catadioptric imaging
2 system comprises a first catadioptric element, a second catadioptric element, and a beam
3 splitter between the first and second catadioptric elements.

1 32. The interferometry system of claim 30, wherein the source assembly includes
2 a source-side mask defining an array of pinholes.

1 33. The interferometry system of claim 32, wherein the detector-side mask and
2 the source-side mask are implemented by the same mask.

1 34. The interferometry system of claim 21, wherein the source assembly
2 comprises a pulsed source for generating the array of input beams.

1 35. The interferometry system of claim 29 further comprising an object stage for
2 holding the object.

1 36. The interferometry system of claim 35 further comprising a first transducer
2 assembly for moving the object stage so as to scan the object during operation.

1 37. The interferometry system of claim 36 further comprising a second
2 transducer assembly for moving the detector-side mask during operation.

1 38. The interferometry system of claim 37 further comprising a controller
2 programmed to cause the first transducer to move the object while at the same time
3 causing the second transducer assembly to move the detector-side mask so that the
4 detector-side mask tracks a conjugate image of the substrate during operation.

1 39. A method of making interferometric measurements of an object, said method
2 comprising:
3 generating a input beam;
4 deriving first and second measurement beams from the input beam;
5 shifting the first measurement beam in phase relative to the second measurement
6 beam by a first amount;
7 focusing the first and second measurement beams onto a spot on or in the object
8 to produce a first return measurement beam and a second return measurement beam, said
9 first return measurement beam resulting from forward reflection and/or forward
10 scattering of the first measurement beam by the object plus backscattering of the second
11 measurement beam by the object, said second measurement beam resulting from forward
12 reflection and/or forward scattering of the second measurement beam by the object plus
13 backscattering of the first measurement beam by the object;
14 shifting the second return measurement beam in phase relative to the first return
15 measurement beam by a second amount;

16 interfering the first and return second return measurement beams with a reference
17 beam to produce an interference beam; and
18 focusing the interference beam onto the detector element.

1 40. The method of claim 39, wherein the first and second amounts of phase shift
2 are such that the backscattering portions of the first and second return measurement
3 beams substantially cancel and the forward reflected and/or forward scattering portions of
4 the first and second return measurement beams reinforce each other.

1 41. The method of claim 39, wherein the first and second amounts of phase shift
2 are equal.

1 42. The method of claim 41, wherein the first and second amounts of phase shift
2 are both equal to $\pi/2$.

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